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EOS Data and Operations System Requirements

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National Aeronautics and Space Administration

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Volume 2

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Change Information Page

ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Original	03/17/92	ALL	Baseline
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CH02	10/08/92	2-3, 2-4, G-1	CCR 423-01-35-002
CH03	10/08/92	2-5	CCR 423-01-35-003
CH04	10/08/92	2-3	CCR 423-01-35-005
CH05	10/08/92	G-1	CCR 423-01-35-006
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CH07	10/08/92	2-1	CCR 423-01-35-008
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CH09	04/02/93	1, 2, 3, 4, 5, 30, 31, 32, 33, 34, 35	CCR 423-01-35-007-R1
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CH11	07/19/93	21, 22, 23, 24	CCR 423-01-35-010
CH12	07/19/93	3	CCR 423-01-35-013
CH13	09/13/93	6, 7, 8, 9, 10, 25, 26, 27, 28, 29	CCR 505-01-35-014
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Contents

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Section 1. Introduction

The Earth Observing System (EOS) is central to the Mission to Planet Earth, NASA's contribution to the Global Change Research Program. The EOS consists of three main components: the EOS Scientific Research Program, the Earth Observing System Data and Information System (EOSDIS) and the EOS Space Measurement System (EOSSMS).

This document provides consolidated high-level requirements for the Level 0 data operations in support of the EOS. They are expressed in terms of an EOS Data and Operations System (EDOS) even though the implementation could be through more than one contract. This document is a companion to the Earth Science Data and Information System (ESDIS) Project Level 2 Requirements Volume 0: Overall ESDIS Project Requirements (to be referred as "Level 2 Volume 0"). Level 2 Volume 0 provides necessary information for understanding the Mission to Planet Earth, the context of the DOS, and the requirements hierarchy, requirements affecting EDOS, such as those pertaining to the mission baseline and instrument complement, can be found in Level 2 Volume 0 and will be referenced but not repeated here. CH03

As a goal, EDOS shall minimize development and lifecycle costs.

Section 2. Requirements

2.0 Programmatic Requirements

2.0.1	EDOS shall include development, testing, operations, and maintenance for the life of the EOS plus three years.	220001
2.0.2	EDOS shall be developed in an incremental manner with capabilities phased to meet EOS mission requirements as shown in tables 1 and 2.	220002
2.0.3	EDOS shall perform processing required to produce and distribute level 0 data sets as defined in Appendix D, Volume 0, #423-10-01-0.	220003
2.0.4	EDOS shall provide a safe backup of all Level 0 data sets produced by the EDOS.	220004
2.0.5	EDOS shall support the EOS Ground System Independent Verification and Validation (IV&V) of the EDOS systems functions.	220005
2.0.6	EDOS shall make available to NOAA, within 3 hours, raw data from designated instruments, (see Appendix D, Volume 0, #423-10-01-0) using rate buffered service.	220006
2.0.7	The EDOS implementation team shall interface with the EOSDIS Core System (ECS) implementation team, including the EOS Ground System Independent Validation and Verification activities, to assure the development of mutually compatible systems.	220007
2.0.8	EDOS shall conform to the reliability and quality assurance requirements in accordance with NASA Handbook 5300.4, (1A-1) Reliability and (1B) Quality Assurance.	220008
2.0.9	EDOS shall maximize the effective use of applicable international, national, commercial, agency, and GSFC standards for development and operations.	220009
2.0.10	EDOS shall maximize effective use of systems management standards (eg; OSF/DME, and OSI UI/Distributed Management Framework).	220010

CH02

2.1 System Level Requirements

2.1.1	EDOS shall maintain/assure the integrity of all data received, stored, and transmitted.	220011
2.1.2	EDOS shall provide data quality determination and analysis, and accounting; fault isolation; performance monitoring and control; error correction, recovery processing, and related quality control procedures and processes.	220012
2.1.3	EDOS shall support EOS pre-launch activities (e.g., operational readiness tests and simulations).	220013
2.1.4	EDOS shall support operations and testing concurrently.	220014
2.1.5	EDOS shall provide the capability to distribute data by electronic transmission.	220015
2.1.6	EDOS shall provide a sustaining engineering capability.	220016
2.1.7	EDOS shall support operations 24 hours per day, 7 days per week on a continuous basis.	220017

2.2 Space/Ground Communications And Processing Requirements

2.2.0 System Level Processing Requirements

2.2.0.1	EDOS shall introduce, on average, no more than one bit error for 10E+12 bits processed.	220018
2.2.0.2	EDOS shall support the Consultative Committee for Space Data Systems (CCSDS) standards and recommendations for telecommand for forward link data.	220019
2.2.0.3	EDOS shall support the CCSDS AOS Grade of Service 2.	220020
2.2.0.4	EDOS shall incorporate L0 or L1A data on physical media, from any DAAC in the event of an EDOS backup archive loss of data.	220021
2.2.0.5	EDOS shall have a contribution to the overall realtime operations (command up to acknowledge back) loop delay of no more than 1.75 sec.	220022
2.2.0.6	EDOS shall deliver expedited data sets to the ECS ingest point within 3 hours from the end of the spacecraft contact session.	220023

2.2.1 Return Link Processing Requirements

2.2.1.1	EDOS shall provide the capability for capture of all return link data on separate, non-volatile, physical media, and for storage for 30 days after receipt.	220024
2.2.1.2	EDOS shall provide frame synchronization for return link data at rates up to 150 Mbps from one channel.	220025
2.2.1.3	EDOS shall provide Reed-Solomon (Grade of Service II) decoding on the return link data as required.	220026
2.2.1.4	EDOS shall provide AOS CCSDS Path and Virtual Channel Data Unit services on return link data.	220027
2.2.1.5	EDOS shall provide real-time processing support as shown in Appendix D, Volume 0, #423-10-01-0.	220028
2.2.1.6	EDOS shall provide processing support for data that are downlinked in realtime or played back from the spacecraft recorder.	220029
2.2.1.7	EDOS shall support CCSDS COP-1 by extracting the Command Link Control Word (CLCWs) from the trailers of the return link Coded Virtual Channel Data Units (CVCDUs) and passing them on to the EOS Operations Center (EOC).	220030
2.2.1.8	EDOS shall provide rate buffered delivery service for return link data (as shown in Appendix D, Volume 0, #423-10-01-0).	220031
2.2.1.9	EDOS shall have a contingency plan for receiving and processing science data received at the AM-1 backup Ground Stations in the event of a failure in the primary return link mode.	220032
2.2.1.10	EDOS shall support the EOS spacecraft clock correlation functions.	220033

2.2.2 Forward Link Processing Requirements

2.2.2.1	EDOS shall receive Command Data Blocks from the EOC (as shown in Appendix D, Volume 0, #423-10-01-0).	220034
2.2.2.2	EDOS shall transfer EOS forward link data to the scheduled ground terminal.	220035

2.2.3 Data Processing Requirements

2.2.3.1	EDOS shall provide processing support to produce Level 0 data sets at the average incoming data rates as specified in Appendix D, Volume 0 #423-10-01-0.	220036
2.2.3.2	EDOS shall provide expedited processing support consisting of Level 0 data sets from single spacecraft contact sessions as specified in Appendix D, Volume 0, #423-10-01-0.	220037
2.2.3.3	EDOS shall deliver Level 0 data sets to the ECS ingest points, within 24 hours of receipt of all appropriate input data at GSFC, 99% of the time, in accordance with Appendix D, Volume 0, #423-10-01-0.	220038
2.2.3.4	EDOS shall provide the capability to distribute Level 0 data sets by physical media. (Performance TBD).	220039
2.2.3.5	EDOS shall provide for the retrieval and distribution of archived data to recover from loss of Level 0 data sets at an EOSDIS DAAC site.	220040
2.2.3.6	EDOS shall distribute Level 0 archived data sets on physical media.	220041
2.2.3.7	EDOS shall provide the capability to reprocess up to 5% of return link data in response to a specific DAAC request regarding questionable Level 0 data received within the last 30 days.	220042
2.2.3.8	EDOS shall clear an 8 hour backlog in addition to normal processing within 32 hours after all the data has been received by the Level 0 processing functions.	220063
2.2.3.9	EDOS shall nominally produce 2 (TBR) hour data sets in 4 (TBR) hours after receipt of data at the LZPS.	220064

2.3 Operations Management Requirements

2.3.1	EDOS shall provide the capability to manage EDOS system operations, administration, planning, and security functions.	220043
2.3.2	EDOS shall provide to the ECS and other external management entities summary status, quality, and accounting information on all mission data handling and processing.	220044
2.3.3	EDOS shall support end-to-end fault isolation for all EDOS provided services.	220045
2.3.4	EDOS shall provide the capability to remotely operate EDOS functions at EOSDIS Ground Stations.	220046

2.4 Interface Requirements

(As defined in Appendix D, Volume 0, #423-10-01-0)

2.4.1	EDOS shall interface with the EOSDIS Core System (ECS).	220047	
2.4.2	EDOS shall provide the interface with the Space Network (SN) at White Sands.	220048	
2.4.3	EDOS shall provide an interface with the Alaska Ground Station (AGS), Svalbard Ground Station (SGS), and with the Wallops Orbital Tracking Station (WOTS), for contingency mode operations.	220049	CH01
2.4.4	EDOS shall interface with spacecraft integration and test facilities to support pre-launch activities, including spacecraft integration.	220050	
2.4.5	EDOS shall interface with the launch processing site to support pre-launch activities.	220051	
2.4.6	EDOS shall interface with the NOAA as defined Appendix D, Volume 0, #423-10-01-0.	220052	
2.4.7	EDOS shall interface with international partners as defined in Appendix D, Volume 0, #423-10-01-0.	220053	
2.4.8	EDOS shall provide an interface with the EOSDIS Ground Stations.	220054	
2.4.9	EDOS shall provide an interface with the AM-1 backup Ground Stations for science contingency mode operations.	220055	

2.5 EDOS Operational Availability

The operational availability (Ao) of EDOS shall be determined by the following formula:

$$Ao = \frac{\text{Time Service is Available}}{\text{Time Service is Available + Time Service is Not Available}}$$

The time service is available is measured over a contiguous 10,000 hour interval, except that any loss of availability due to loss of facility services, such as power or air conditioning, shall not be counted. The time service is not available shall include all times service is not available due to corrective maintenance downtime, administrative downtime, logistics supply downtime, and preventive maintenance downtime.

2.5.1	EDOS shall predict and periodically assess maintainability by measuring the actual Mean-Time-to-Restore-Service (MTTRS) and comparing to the required MTTRS.	220056
2.5.2	The maximum time-to-restore-service shall not exceed twice the required MTTRS in 99 (TBR) percent of failure	220057

occurrences.

2.5.3	EDOS functions shall have an operational availability of 0.96 at a minimum and an MTTRS of four (4) hours or less, unless otherwise specified. This requirement covers equipment including: (a) "Non-critical" equipment configured with the critical equipment supporting the functional capabilities in the requirements (b) Equipment providing other functionality not explicitly stated in the RMA requirements that follow.	220058
2.5.4	EDOS shall have an operational availability of 0.9998 at a minimum and an MTTRS of one (1) minute or less for forward and return realtime processing, except for data capture.	220059
2.5.5	EDOS shall have an operational availability of 0.998 as a minimum and a MTTRS of 2 hours or less for non real-time mission data processing.	220060
2.5.6	EDOS shall have an operational availability of 0.999 at a minimum and an MTTRS of one (1) minute or less for data capture.	220061

Figure 1. EOS Ground System Architecture (Deleted) CH03

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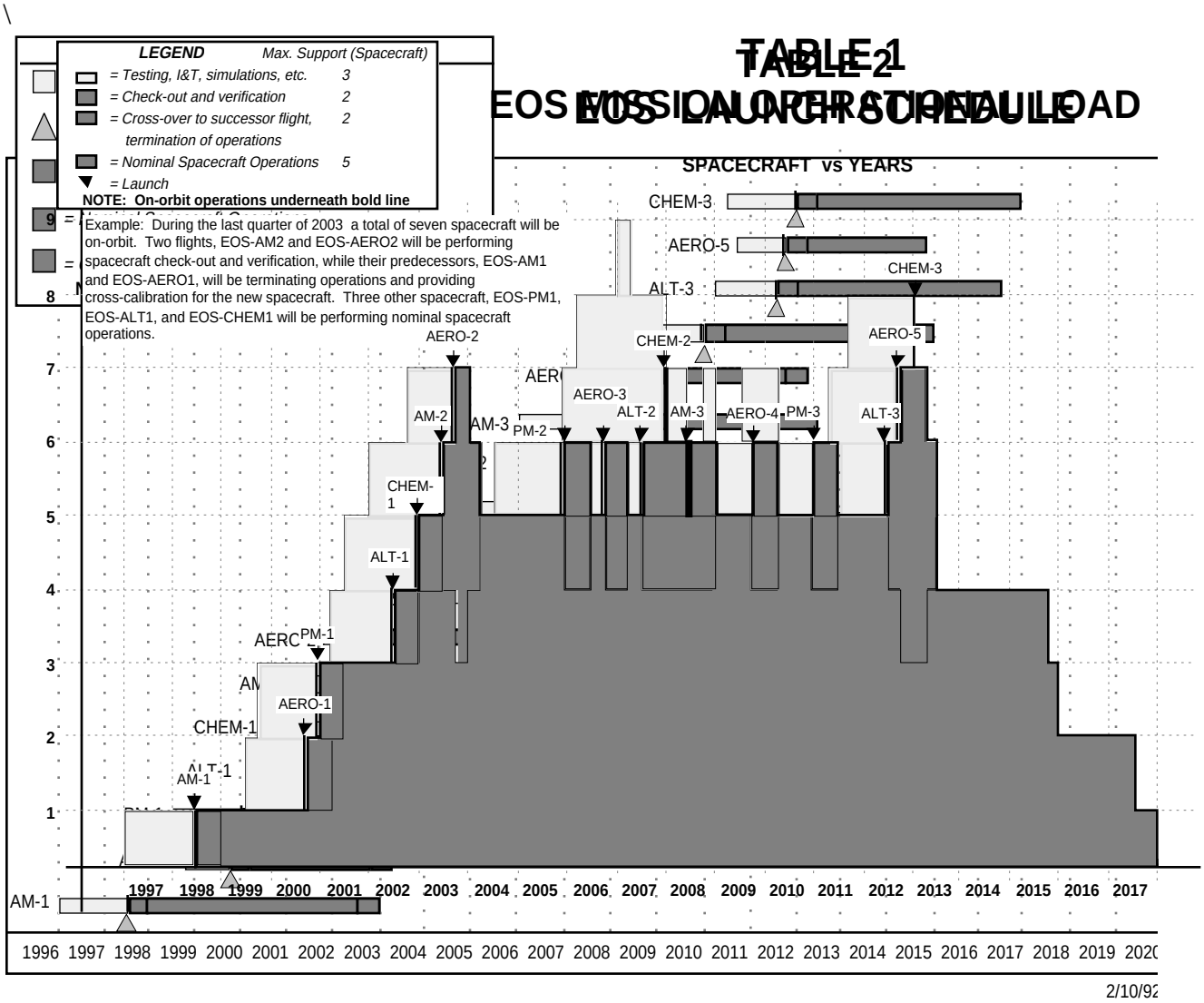
Glossary

Corrective Maintenance: All actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: Localization, Isolation, Disassembly, Interchange, Reassembly, Alignment, and Checkout.



Downing Event: The event which causes an item to become unavailable to initiate its mission (the transition from UP-TIME to DOWN-TIME).

Mean-Time-To-Restore-Service (MTTRS): The total corrective maintenance time, associated with downing events, divided by the total number of downing events during a stated period of time. Excludes time for off-system maintenance and repair of detached components.

Preventive Maintenance: All actions performed in an attempt to retain an item in specified condition by providing systematic inspection, detection, and prevention of incipient failures.

Rate-Buffered: Rate Buffered data delivery to be initiated within 5 minutes of the end of TDRSS session.

Contingency Mode: Command and spacecraft telemetry operations in the event of a nonavailability of TDRSS capability.

Data Driven: A system that uses routing identification information resident in the communications data structures to provide all necessary information in order to establish end-to-end communications.

Realtime: Realtime describes processing performed on mission data with minimized delay through EDOS.

Acronym List

ADC	Affiliated Data Center	
AGS	Alaska Ground Station	CH01
AOS	Advanced Orbiting System	
CCSDS	Consultative Committee for Space Data Systems	
CLCW	Command Link Control Word	
CLTU	Command Link Transmission Unit	
COP-1	Command Operations Protocol - 1	
CVCDU	Coded Virtual Channel Data Units	
DAAC	Distributed Active Archive Center	
EBnet	EOS Backbone Network	CH01*
ECS	EOSDIS Core System	
EDOS	EOS Data Operations System	
EOC	EOS Operations Center	
EOS	Earth Observing System	
EOSDIS	Earth Observing System Data and Information System	
EOSSMS	EOS Space Measurement System	
FDF	Flight Dynamics Facility	
FST	Field Support Terminal	CH01
ICC	Instrument Control Center	
ICF	Instrument Control Facility	
IMS	Information Management System	
IST	Instrument Support Terminal	
IV&V	Independent Verification and Validation	
MDT	Mean Down Time	
MTTRS	Mean Time To Restore Service	

NASCOM	NASA Communications	
NCC	Network Control Center	
NMI	NASA Management Instruction	
ODC	Other Data Center	
PGS	Product Generation System	
RMA	Reliability, Maintainability, Availability	
SCF	Science Computing Facility	
SGS	Svalbard Ground Station	CH01
SMC	System Management Center	
SN	Space Network	
TBD	To Be Determined	
TBR	To Be Reviewed (Revisited)	
TCTF	Telecommand Transfer Frames	
TGT	TDRSS Ground Terminal	
WOTS	Wallops Orbital Tracking Station	CH01